Piñon-Juniper Restoration Research on the Pajarito Plateau

Samuel R. Loftin
Los Alamos National Laboratory

Brian F. Jacobs
Bandelier National Monument

Richard G. Gatewood
Colorado State University

ABSTRACT

Approximately 50% of the Pajarito Plateau is piñon-juniper (p-j) woodland and juniper savanna. The majority of this ecosystem is in poor condition with high erosion rates, increased wildfire hazard, and degraded archeological sites. To address these problems, Bandelier National Monument (BNM), the Santa Fe National Forest (SFNF), the USDA Forest Service Rocky Mountain Research Station (RMRS), and Los Alamos National Laboratory (LANL) are conducting collaborative research on aspects of p-j woodland restoration.

INTRODUCTION

Climate and past land management have led to degradation of p-j woodlands throughout the western United States (Allen and Breshears 1998; Monsen and Stevens 1999). Symptoms of woodland degradation include high tree density, high wildfire risk, low understory abundance and diversity, and high soil erosion rates which lead to archeological site damage. We have designed and implemented a series of research projects to test the effects of woodland restoration treatments. All treatments include thinning trees but exact prescriptions differ. Earlier projects were smaller, plot-based studies that were primarily concerned with vegetation response. Projects have become progressively larger and more complex to address the effects of thinning treatments on soil erosion and watershed hydrology over a greater range of site conditions. Because of the size of the latter treatments, replication of individual projects has been difficult. However, by comparing the results of these projects we can begin to piece together a picture of the fine-scale and broad-scale effects of our restoration program.

PROJECTS

BNM1

In 1992, a two-year study was established on BNM (Figure 1, BNM1) to evaluate various combinations of revegetation techniques (seeding, mulching, fertilizing, and raking) with woodland treatments (minimal thinning, girdling, uncut controls) for establishment of native perennial grass from seed in degraded woodland areas (Chong 1993, 1994). The objectives of this study (i.e., to re-establish grass cover in bare soil canopy interspaces) were based on the assumptions that both perennial grass seed source and suitable micro-site conditions were limiting. The study found that favorable microsite conditions were strongly correlated with success of grass establishment from seed.

BNM2

In 1994, a project was initiated to evaluate overstory thinning, slash mulching, and supplemental seeding techniques on study sites representing a range of environmental conditions across the Pajarito Plateau (Jacobs and Gatewood 1999). Two study sites were established on BNM and USFS lands in 1994 and a third was established on BNM in 1995 (Figure 1; BNM2 a, b, and c, respectively). The objectives of this study were to manipulate water availability (in addition to microsite conditions and seed source) to re-establish effective herbaceous cover on degraded woodland sites. Results from this treatment were highly significant, with two of the sites having a two-to-seven fold increase in total herbaceous cover by two years post-treatment. Supplemental seeding sub-treatments appeared to confer only minor benefits to the total herbaceous response.

Untreated (1994)

Two years Post-treatment (1997)

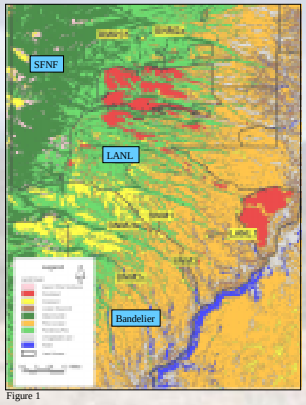

Figure 1

RMRS1

This project was established in 1994 on the SFNF (Figure 1, RMRS1) to test the soil stability and vegetation response within a large (20 acre/ 8 ha) thinned area. The larger size of this treatment was more representative of management-scale treatments than the earlier plot studies. This is the first of our studies to use soil erosion bridges to quantify changes in soil microtopography. Cover of herbaceous vegetation increased by three fold after three years (Loftin 1999). Few significant changes in soil microtopography have been observed. This site burned in the Cerro Grande Fire and research here has since changed focus. Thinned areas burned with low intensity while the untreated area burned with high intensity, and virtually every tree was killed before the fire continued into the woodland north of it. We will now be using this project to evaluate the effects of wildfire on treated and untreated p-j woodlands.

BNM3

In 1996, a 100 acre (40 ha) paired watershed study was established on Bandelier (Figure 1, BNM3) to evaluate the overstory thinning/slash mulching methodology at a functional watershed scale and across a greater variety of pre-treatment conditions. Based on earlier results, supplemental seeding techniques were not included. In addition to vegetative cover, response to treatment was also measured in terms of herbaceous biomass, soil erosion (changes in soil surface elevation and sediment production), soil moisture and temperature, and bird, butterfly, and ground dwelling arthropod abundance and diversity. Elk exclosures were established within the thinned and control areas to evaluate the environmental response relative to presence or absence of grazing pressure. In addition, prehistoric cultural sites were monitored for changes in herbaceous cover across the two treatment areas. Results were comparable to earlier studies with a two-to three-fold increase in total herbaceous cover after two years. Studies have also shown that localized soil erosion is less in the treated area.

LANL1

In 2000, a 150 acre (60 ha) paired watershed study was initiated on LANL (Figure 1, LANL 1). Although the vegetation response to thinning treatments implies a positive watershed response, we have no hydrologic data to verify this assumption. This project will evaluate the effects of the thinning and mulching treatment on watershed hydrology, water quality, soil erosion, and vegetation. Initial funding for this study was provided by the LANL Biological Resources Management Planning Program and was used to identify and instrument watersheds. Each watershed will be instrumented with meteorological stations to quantify precipitation inputs and other meteorological variables. In addition, watersheds will be instrumented to record timing and amount of flow, as well as collect water samples for constituent analyses. We plan to begin pretreatment monitoring and watershed calibration in summer 2001. The thinning treatment is planned for 2004.

Four years post-treatment (1999)

Post fire (2000)

LESSONS LEARNED

Some common themes and lessons have been learned from one or more studies in this research program.

- Supplemental seeding treatments have been only marginally successful. However, seeding treatments may be useful in areas where native grass seed source is not adequate and little residual vegetation remains and where planting techniques are not severely constrained by wilderness or cultural resource values.
- Thinning the trees reduces competition for water and the slash mulch increases the quantity and quality of microsites for seed germination and growth.
- Residual herbaceous vegetation and plant materials (i.e. seed and rhizomes in the soil) respond rapidly to the thinning and mulching treatment and often double or triple in total cover within two years. Response is highly dependent on initial site conditions and rainfall following the treatment. Initial increases in herbaceous cover are largely a response of annual and bi-annual forbs with increases in grass cover becoming significant by the third growing season post-treatment.
- The BNM3 study has shown that localized soil erosion is reduced by the thinning and mulching treatment.

LITERATURE CITED

Allen, C.D. and D.D. Breshears. 1998. Drought-induced shift of a forest-woodland ecotone: rapid landscape response to climate variation. Proceeding of the National Academy of Sciences USA 95:14839-14842.

Chong, G. W. 1994. Recommendations to improve revegetation success in a pinyon-juniper woodland in New Mexico: a hierarchial approach. M.S. thesis, Univ. of New Mexico, Albuquerque, NM.

Chong, G. W. 1993. Revegetation of pinyon-juniper woodlands with native grasses. In: Aldon, Earl F. and Douglas W. Shaw (eds). Managing Pinon-Juniper Ecosystems for Sustainability and Social Needs, USDA Forest Service GTR RM-236.

Jacobs, B. F. and Gatewood, R. G. 1999. Restoration studies in degraded piñon-juniper woodlands of north-central New Mexico. *In:* Monsen, S.B., R. Stevens (comps.) Proceedings: ecology and management of pinyon-juniper communities within the Interior West. September 15-18, 1997, Provo UT. Proc. RMRS-P-9. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Loftin, S. R. 1999. Initial response of soil and understory vegetation to a simulated fuelwood cut of a pinyon-juniper woodland in the Santa Fe National Forest. *In:* Monsen, S.B., R. Stevens (comps.) Proceedings: ecology and management of pinyon-juniper communities within the Interior West. September 15-18, 1997, Provo UT. Proc. RMRS-P-9. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Monsen, S.B. and R. Stevens. 1999. Symposium on pinyon and juniper ecology, restoration, and management: introduction. pages 3-4 *In:* Monsen, S.B., R. Stevens (comps.) Proceedings: ecology and management of pinyon-juniper communities within the Interior West. September 15-18, 1997, Provo UT. Proc. RMRS-P-9. Ogden UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

ACKNOWLEDGEMENTS

The authors would like to thank Rhonda Robinson, for producing this poster with little time and less space. We also thank all the personnel (too numerous to name) that have helped with the fieldwork on these projects.

LA-UR-01-1355